The Effects of Mode Perceptions on Intercity Mode-Choice Behavior in Saudi Arabia

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Abstract
The conventional mode choice models mostly consider quantitative variables in their model estimation although mode choice may be affected by the qualitative perception levels of service variables. This study aimed to investigate the effect of incorporating mode perception into the modeling of mode choice process for intercity travel in Saudi Arabia after developing and testing scales for quantifying the perceptions of mode privacy, convenience, comfort and reliability. In order to investigate the effects of mode perceptions, multinomial logit mode choice models were calibrated for business trips as well as social/recreational trips. This study reveals that the perception of mode comfort significantly affects the choice of the travelers for the mentioned three types of trips but perception of mode is significant for business trips only. The study concluded that it is not worthy to use these variables in planning stages due to the difficulty and cost in obtaining the mode perceptions. However, the variables could be quite useful in identifying deficiencies of the intercity modes as perceived by travelers and therefore could help operators in improving the required services.
Keywords: mode perception, mode choice.

1. INTRODUCTION

According to Ministry of Transport (MOT), the total financial requirements of the transport sector including Ministry of Transport, Saudi Ports Authority, SRO and the Civil Aviation Corporation during the Eighth Development Plan period (2005-2009) is about SR 35,641 million which will be used mainly to finance expansion of the road, rail and port infrastructure, maintenance and operation of the existing facilities, development of manpower, provision of supplies and equipment as well as the preparation of studies and research required for development and improvement of the sector (MOT,2008). The MOT has executed a modern network of 53,000 km roads at the end of 2005 (International Tunneling and Underground Space Association, 2008). On the other hand, air transportation has undergone considerable expansions and developments during the past years which results 25 international and domestic airports. The number of arriving and departing passengers handled by all airports increased at an average annual rate of 15%, rising from 1.6 million in 1970 to 30 million in 1998 (Ba-Fail, 2004).

During the last two decades millions of riyals have been spent on building new transportation infrastructure such as highway networks, airports, railway stations to meet the increasing travel demand. To avoid the problems associated with under-design or over-design of components of the transportation systems, it was considered necessary to study the behavior of travelers to determine the factors influencing their mode choice.

In Saudi Arabia, people rely heavily on private cars for intercity trips as well as short intercity trips. Due to the large area of the Kingdom (2,240,000 km^2) and long distances between cities, travelers consider a multitude of modes such as air, bus and car when they make their choice for intercity trips. The conventional mode choice models mostly consider quantitative variables in their model estimation. However, trip makers in their mode choice may be affected by other perceived levels of service variables such as comfort, convenience, reliability and privacy of modes. Some of these variables may be as significant as travel cost or travel time or even more so. The research data was generated via another study (Al-Ahmadi, 1993 and Al-Sughaiyer, 1994). The purpose of which was to build intercity disaggregate behavioral models for Saudi Arabia. This research investigated the significance of introducing mode perception and in particular mode comfort, convenience, privacy and reliability on the intercity mode choice models. Privacy may be more important in Saudi Arabia due to cultural reasons.

This paper is divided into six sections. First few sections deal with problem statement, research methodology, data collection and analysis. The remaining sections describe model calibration and validation. Finally, the author provides insightful conclusions and recommendations regarding the mode choice model for including perception variables in the context of Saudi Arabia.

2. LITERATURE REVIEW

Local and intercity travelling significantly differ from each other. The intercity travelling is not as much frequent as the local or ordinary travelling, that is why the people who intend to travel intercity have very limited information and there may be a random behavior in travel. Furthermore the intercity travelling is most of the times an elastic travel such as entertainment, business, visiting friends and shopping etc. The number of intercity travelers is smaller than that of the intra city. The survey of Yangtaze River Delta Metropolitan says that intercity traveling is 13% of the total travelling and further the travel time and information varies, ultimately leading to certain changes in mode of travelling. So it can be said that the procedure of choosing the commuter travelling mode is more complicated and volatile (Wu et al, 2016)

The existing work on the choosing behavior of the intercity travelers is based mainly on random utility theory. A rank logic model has been formulated using the factors of the commuter travel the findings of the model leads to the RL model which tends to be more accurate and reliable in the researches done the topic of intercity travelling (Wang et al, 2012). An integrated multilevel nested logic model containing the choice of trip, destination, route and the suggested model has the application in Shenzhen commuter railway users' demand forecasting successfully (Lu 2014). Another model called MNL model set by Chen (2013) which is based on the behavior of commuter traveler using the data provided by Yangtze River Delta, then a simplified and modified Exogenous Sample Maximum Likelihood Estimator (ESMLE) and Weighted Exogenous Sample Maximum Likelihood Estimator (WESMLE) to make modification the previous model showing less frequent commuter travelling mode choice model with WESMLE having big room for the improvement and accuracy.

The research on discrete choice models emphasizing importance of the explicit treatment of psychological factors affecting decision making started almost from the 80's. (See Koppelman and Hauser, 1979; McFadden, 1986). According to Ben-Akiva et al, (2002) the guiding philosophy in these developments is the incorporation of psychological factors which leads to a more behaviorally realistic representation of the choice process, and consequently, better explanatory power. A significant number of studies contributed in measuring the general attitudes towards a variety of transportation aspects but with less emphasis on mode choice. Those research works are mostly descriptive rather than analytical and attempted to outline depict the attitudes of Americans towards mobility, their feelings concerning the automobile's role in society, their basic motivations for driving, and their preferences for transportation innovations. The National Survey of Transportation Attitudes and Behavior (McMillan, 1970) contributed in determining the relationship between transportation attitudes and mode choice, which results the registration of attitudes, opinions and values regarding automobiles. Lansing and Hendricks (1964) found out various reasons and motivations for car and transit mode. They discovered that mode choice was not sensitive to cost as 75% of the respondents mentioned that they had never calculated the cost of driving to work.

Ackoff (1965) formulated and tested a modal-split model which was developed on an individual's relative evaluation of four attributes namely cost, travel time, comfort and convenience. It consists of four vectors explaining the effect of change of the service characteristics to preferred mode. Spear (1974) investigated the effect of a generalized convenience variable in mode choice for work trips and measured convenience by using fourteen individual attributes. A convenience index was constructed using indicated respondent satisfaction to a pre-selected subset of ten attributes and got incorporated in a mode-choice model. This innovate approach improve the fit of the model and cause a major decline in the alternative specific constant and it significance.

Spear (1976) compared models with time and cost variables to models with time, cost and convenience variables and discovered that explanatory power of the second mode-choice model is significantly stronger. But his model did not include attitudinal variables related to safety could be a strong influencing factor behind mode-choice in individuals (Flanagan, 2007). Prashker (1977) introduced attitudinal variable named reliability to mode choice behavior for work trips. The reliability performance of the modes was measured by using psychometric scaling techniques, including factor analysis and multi-dimensional scaling technique. It was shown that reliability measures are statistically significant and improve the explanatory power of the models.

Aljarad and Black (1995) analyzed intercity mode choice in the Saudi-Bahrain corridor using disaggregate transport mode choice models and developed model for the Riyadh-Bahrain corridor and the Eastern Province-Bahrain corridor. The accuracy of the models were improved due to the use of disaggregate data, survey data on individual choices and attributes. The study also used several socioeconomic variables including immediate decision time and automobile availability, and policy-oriented variables including out-of-vehicle time and frequency of service.

Liu and Li (2003) travel behavior survey and model calibration to investigate the importance of a few proposed factors in the travel choice decision process and found out that it is possible to incorporate safety and reliability together with travel time and monetary cost variables into the intercity travel choice model. The estimated model with additional safety and reliability variables is logical because of having adequate goodness of fit indices, correct signs, and significant parameters.

Flanagan (2007) conducted an analysis with the help of bivariate statistics and probit regression modeling to evaluate the impact of perceptions on the choice to take a private automobile or public transit for the journey to work. The study found out that indicating safety concerns, price of gasoline or highway congestion to be a large problem is negatively correlated with choosing public transit as the dominant mode choice. Although the results are statistically significant results, the marginal effects of safety, price of gasoline and highway congestion on predicting dominant mode are relatively small, with each separately impacting mode choice by less than one percent.

Koppelman and Sethi (2005) developed the *Heterogeous* Generalized Nested Logit (GNL) combining the Generalized Nested Logit model that allows for non-independent errors, the Heteroscedastic MNL which allows non-constant errors across observations, and the Covariance Heterogeneous NL model which allows for non-constant correlation structure across observations.

Although the importance of including attitudinal variables in mode choice models is well established, the reliability of variables representing attitudes and perceptions has not always been easily quantifiable (Flanagan, 2007). The attitudinal data gathered through surveys from open-ended questions or anecdotes, which is not always reliable (Pendyala and Bhat 2004). Many of the studies use local level data rather than national datasets which suffer from less reliable estimates due to small sample size (Flanagan, 2007). Johansson et al (2006) conducted a survey which was limited only to choice riders those with access to a car and access to public transportation, in Sweden to evaluate the impact of individual characteristics, safety preferences and attitudes towards flexibility and comfort, and found out that both flexibility and comfort were significantly influence an individual's mode choice. According to this study, traveler values and priorities are critical to determining the type of investments and service improvements that are likely to meet with the greatest success (Pendyala and Bhat, 2004).

3. RESEARCH METHODOLOGY

The research was divided into two stages. The first stage focuses on the development of attitudinal scales for perceptual concepts. In the second stage, behavioral intercity mode-choice models were developed for the purpose of testing the contribution of attitudinal variables in the explanation of intercity travel mode choice behavior.

3.1 Development of Attitudinal Scales

Morikawa et al (2002) and Morikawa and Sasaki (1998) included modal comfort and convenience in transport related applications. Based on the hypothesis that differences in people's attitudes and personality traits lead them to attribute varying importance to environmental considerations, safety, comfort, convenience and flexibility Johansson et al (2006) use indicators of attitudes and personality traits to form latent variables for inclusion in an, otherwise standard, discrete mode choice model. The two most commonly used approaches in transportation planning for quantifying attitudinal model attributes are the use of dummy variables and the use of integer-based proxy variables. The dummy variable approach was used by Purker and Clark (1972) and Lave (1969) in quantifying comfort variable. The alternative approach was implemented by Bock in quantifying comfort and convenience variables (1968). Another approach is based on psychometrics, which is used to quantify qualitative variables and to overcome the shortcomings of earlier approaches. In this research, attitudinal scales were constructed for the purpose of quantifying perceptual variables, using the method suggested by Ergun (1979).

3.1.1 Development of Preliminary Scales

The purpose of this research is to develop scales for measuring comfort, convenience, privacy and reliability of travel which will be used in improving the understanding of intercity mode choice behavior. It was found that mode comfort, convenience and reliability affect the choice of the traveler. Further concept "privacy" was added to these concepts because it was believed to be an important dimension especially considering local customs in Saudi Arabia.

After defining the hypothetical concepts, a pool of items (statements) or attributes describing these concepts was prepared. This set of items was subjected to a verity of tests and revisions at the items analysis stage. After rounds of review and analysis, a total of 31 items were grouped into four hypothetical concepts namely: comfort, convenience, privacy and reliability. A pilot survey was performed to check confirmatory of the four factors and reduce number of items through factor analysis of 31 statements related to mode perceptions. From the pilot survey 135 usable questionnaire were collected and analyzed which meet the standard requirements (Harman, 1970).

Factor analysis was performed based on the principal component technique / varimax rotation using Statistical Analysis System (SAS) package. The rotation helps us to find out the distinctive group of items in corresponding factors otherwise we will get many items with double loadings. Initial factors were determined by common factor analysis through iterations.

The eigenvalue-one criterion was used to determine the number of factors that are sufficient or adequate for the research. The eigenvalue falls below 1.0 at the fifth factor indicating that up to four factors can be extracted.

In order to reduce the number of items under each hypothetical concept to a manageable number, only three items with the highest factor loadings were chosen for each factor to be included in the final survey. Table 1 shows the rotated factor pattern for 3-factor solution as a sample. The results of this solution are summarized in figure 1 and these items are listed below:

CONVENIENCE ATTRIBUTES

ADVPLNG The need for advance planning
LOCSTOP Freedom in choosing locations and time of stops
ACCHOME Accessibility from home

PRIVACY ATTRIBUTES

TKFMLY Talking freely with family members or friends
PRIVACY Having some privacy
FEELINDP Feeling of independence

COMFORT ATTRIBUTES

COMFORT Comfort
CLEANVEH Cleanliness of vehicles
FEELTIRD Feeling tiered at the end of the trip

RELIABILITY ATTRIBUTES

EFWTHRCN The effect of weather conditions on the trip
VEHREPR The feeling that the vehicle would not be delayed for repair
EFWTHRTT The effect of weather condition on the travel time

Table 1: Rotated Factor Pattern for Three-Factor Solution

Variable	Factor 1	Factor 2	Factor 3	Variable Description
LOCSTOP	0.85099	-0.21863	-0.6095	Location and time of stops
ACCHOME	0.81465	-0.04079	0.06274	Accessibility from home
FEELINDP	0.79691	0.31135	0.13162	Feeling of independence
TKFAMLY	0.77811	0.27307	0.11450	Talking freely with family
ADVPLNG	0.75525	-0.15351	0.01659	Need for advance planning
PRIVACY	0.710049	0.43513	0.08568	Have some privacy
COMFORT	0.03871	0.81494	0.27313	Comfort
CLEANVEH	0.25483	0.75965	0.17249	Cleanliness of vehicle
FEELTIRD	-0.21989	0.75885	0.28181	Feeling tired at the end of trip
EFWTHRCN	0.02615	0.13131	0.83089	Effect of weather condition
EFWTHRTT	0.00888	0.20934	0.81435	Effect of weather on travel time
VEHREPR	0.17503	0.29772	0.61517	Vehicle not delayed for repair

3.1.2 Development of Survey Instrument

The main survey instrument was designed to satisfy the requirements for the development of an intercity mode-choice model adopting a disaggregate behavioral approach. A self-response questionnaire was distributed to travelers for obtaining necessary information about their intercity trips. The final version of the survey instrument was obtained through the contributions of literature review and pilot survey which include socio-economic variables, level of service variables and trip variables.

A choice-based sampling procedure was used to collect the data which is recommended for an unevenly distributed transportation demand with passengers on roadsides, bus station or planes. According to Richards and Ben-Akiva (1975), a sample of 200 to 500 is reasonable for model calibration. In our case, the total number of observations required for both the calibration and validation process was 600.

4. DATA COLLECTION

The research data was generated via another study (Al-Sughaiyer, 1994). The purpose of which was to build intercity disaggregate behavioral models for all trip purposes. Therefore the data was collected with this goal in mind via interviews performed at air, bus, and at roadsides with automobile passengers.

5. ANALYSIS OF DATA

A total of 867 questionnaires were used for this study excluding captive riders from the analysis. Factor analysis was performed using the main survey data for testing the scales constructed in the pilot survey and to test the basic assumption that the chosen 12 items in the pilot survey represent measures of mode comfort, convenience, privacy and reliability. In this way factor analysis is used in a confirmatory manner because factors were already established in the pilot survey. In Figure 1 the attributes that have high loads on each factor solution are indicated and the factors have been named after the items that have high loadings on them. The number of factors was chosen as four based on eignevalue and the interpretability of the factors. In the two factor solution, the first factor has all of the items related to privacy and convenience. The items included in this factor remain in the three-, four-, and five-factor solution, which indicate that privacy and convenience items are somewhat correlated. In the second factor, comfort and reliability items were loaded. In the three-factor solution, comfort and reliability items split from each other forming separate factors. In the fourth-factor solution, the reliability was split into two factors. As a result of this analysis, it reveals that privacy and convenience are somehow related to each other; however, the "reliability" and "comfort" dimensions appear as separate factors which confirm the analysis done in the pilot survey and the constructed scale. The plot of factor 1 and factor 2 reveals that the items of both privacy and convenience concepts are separated from each other and the items of each concept are concentrated in one location in the plot.

As a result of the factor analysis it can be concluded that privacy, convenience, comfort and reliability constitute different concepts are their effect will be tested in mode choice.

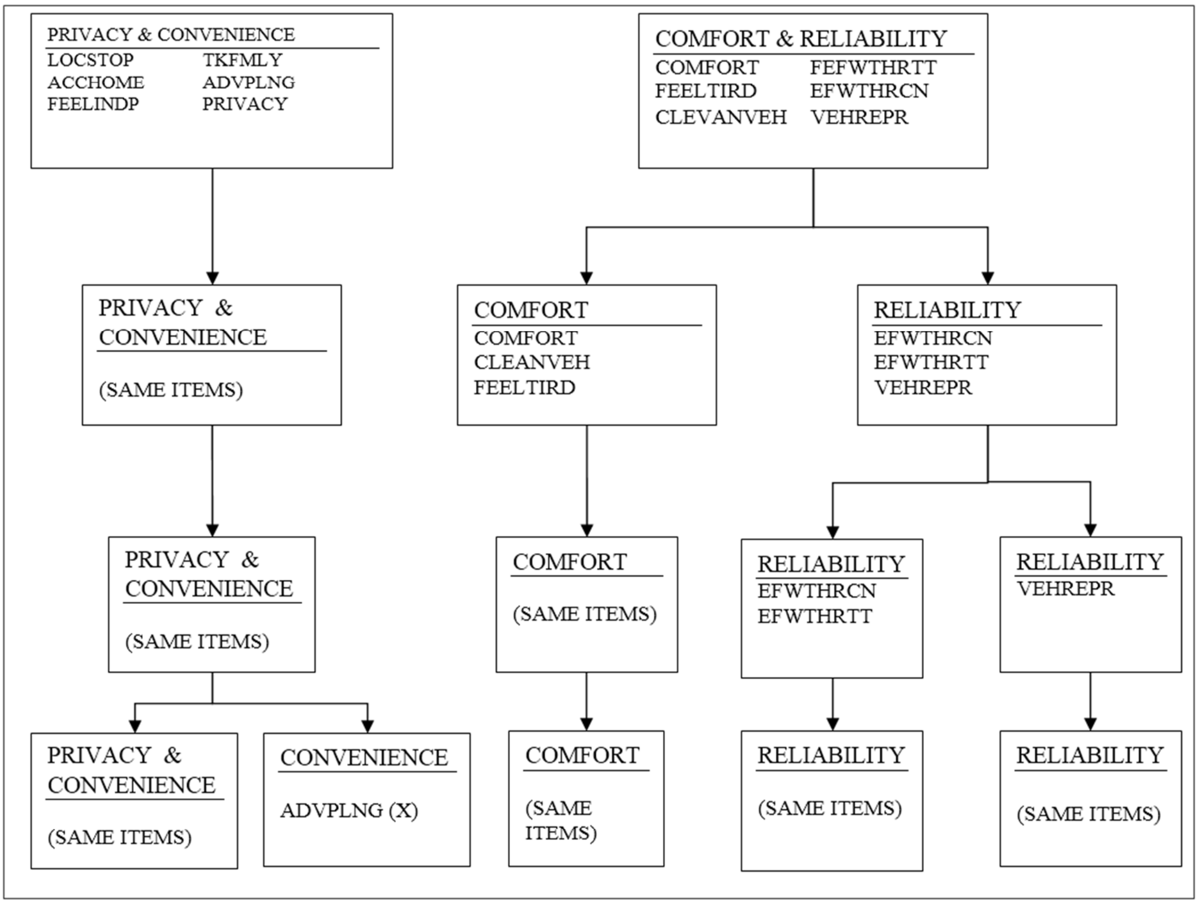

Figure 1: Summary of Factor Analysis Results

(Here, LOCSTOP = Location and time of stops, ACCHOME = Accessibility from home, FEELINDP = Feeling of independence, TKFAMLY = Talking freely with family, ADVPLNG = Need for advance planning, PRIVACY = Have some privacy, COMFORT = Comfort, FEELTIRD = Feeling tired at the end of trip, CLEANVEH = Cleanliness of vehicle, EFWTHRCN = Effect of weather condition, EFWTHRTT = Effect of weather on travel time, VEHREPR = Vehicle not delayed for repair)

6. MODEL CALIBRATION AND VALIDATION

The calibration process is carried out in two stages by emphasizing on the development of mode choice models which were developed without the perceptual concepts, and by incorporating the perceived variables into the previously built models to study their effects.

The model parameters were estimated by fitting a model to the collected data. Using maximum likelihood estimation technique, the BLOGIT package produces estimates of individual parameters by calculating various goodness of fit. The package produces t-test for parameter estimates, log likelihood function value at its maximum, log likelihood function value when all parameters are zero, goodness of fit index, corrected goodness of fit index and prediction success table. In addition the validity of the models was investigated by comparing observed choices and the predicted choices using the calibrated models. Also, the likelihood ratio test for difference between models was used to compare the calibrated models with models that were calibrated using a portion of the collected data other than that used for model calibration.

6.1 Data Segmentation

The data were segmented into business, and social and recreational trips depending on trip purpose. A high percentage of business trips were carried out using the air mode and this segment included a total of 299 observations. Two-third of them was used for model calibration and the remaining portion was used for validation of the calibrated model. Social and recreational trips included a total of 337 observations. Same proportion of data is used for calibration and validation. The selection of calibration and validation data for both trip purposes was randomized.

6.2 Model Specification

Different specifications for the models have been evaluated to determine which specification best replicates the data for different trip purposes. These specifications include the variables that have been found in the literature review to influence the trip-maker choice (such as total cost, egress travel time, access travel time, household income, total travel time , out-of-vehicle travel time , distance , in-vehicle travel time , and waiting time). Composite variables such as total cost / household income and out-of-vehicle travel time / distance are used to modify the impact of the pure level-of-service variables. It is hypothesized that trip-makers with different levels of income perceive travel cost differently.

Some of the models tested exhibited poor statistical goodness-of-fit and/or counter-intuitive signs and were rejected. For example, some models produced a very good fit but it has a counter-intuitive sign in the variable total travel time. In summary, the logic employed to move from one specification to another can be described as follows:

- variables with insignificant coefficients were dropped;
- variables that had the "wrong" signs were dropped;
- variables that were related to level-of-service (i.e., those that might be considered supply variables) were considered in both straightforward ways (e.g., the cost variable was added) and in ratio forms (e.g., cost divided by income);
- sets of variables with high correlations were considered and selected variables were dropped;
- different versions of several variables with "wrong" signs were considered (e.g., out-of-vehicle time was examined as a mode-specific variable); and finally,
- Several intuitively important variables which had been dropped were reconsidered (in the original form and/or, for example, in mode-specific form).

Of all the model specifications tested, the most satisfactory models for Business, and Social / Recreational Trips are presented in Tables 2 and 3 respectively.

6.3 Validation

A test of reasonableness validation process was used first in model calibration phase. This process depends on the reasonableness of the model in terms of the expected coefficient signs, and the reasonableness of the parameters. Validation tests were conducted by the Likelihood Ratio Test statistic (LRTS). This test is asymptotically distributed as χ^2(chi-squared) with degrees of freedom equal to the number of model parameters (Wallin and Wright, 1974).

The results of the validation tests are presented in Table 4. This table shows that there is no significant difference between the observed behavior and the predicted behavior for mode choice for the validation because all of the calculated chi-square values are less than critical chi-square values at a significance level of 0.05 and the associated degrees of freedom which is equal to the number of parameters in the models.

Table 2: Intercity Mode-Choice Models for Business Trips With and Without Perceptual Variables

Independent Variable Name	Model Without Mode Perception		Model With Mode Perception	
	Coefficient	t-Stat	Coefficient	t-Stat
Air Constant	0.091	0;09	0.480	0.39
Bus Constant	2.753	4.02	3.692	4.33
Total Trip Cost Saudi Riyals (SR)[1/]	-0.0051	-4.20	-0.0045	-3.59
In Vehicle Travel Time in hours	-0.2056	-3.97	-0.1821	-3.38
Monthly Household income for air	0.387	3.30	0.391	3.23
Distance Dummy for Car = {1, if distance is less than 900 km; 0, otherwise}	1.381	2.04	1.263	1.87
Dummy for car availability for bus = {1, if traveler has no car; 0, otherwise}	1.150	2.01	0.967	1.64
Dummy for duration of stay for air = {1, if duration of stay is 1-3days; 0, otherwise}	2.071	4.94	2.11	4.85
CONVENIENT (Attitudinal variable)	--	--	0.132	1.68
COMFORT (Attitudinal variable)	--	--	0.130	2.01
LL (β)	-105.35		-101.31	
LL (O)	-180.49		-180.49	
Rho-Sq ρ^2	0.416		0.439	
Rho-Bar sq	0.405		0.425	

Table 3: Intercity Mode-Choice Models for Social Recreational Trips With and Without Perceptual Variables

Independent Variable Name	Model Without Mode Perception		Model With Mode Perception	
	Coefficient	t-Stat	Coefficient	t-Stat
Air Constant	-2.791	-4.09	-4.204	-5.23
Bus Constant	-0.149	-0.17	-0.397	-0.42
Total Trip Cost Saudi Riyals (SR)[1/]	-0.0034	-5.31	-0.0037	-5.23
In Vehicle Travel Time in hours	-0.2100	-3.56	-0.205	-3.24
Monthly Household income for air	0.198	1.92	0.235	2.14
Monthly Household income for bus	-0.374	-2.27	-0.228	-1.32
Distance in Kilometer for car	-0.0037	-4.17	-0.0041	-4.45
Dummy for car availability for bus = {1, if traveler has no car; 0, otherwise}	2.034	3.09	2.254	3.33
COMFORT (Attitudinal variable)	--	--	0.312	4.74
LL (β)	-136.90		-123.529	
LL (O)	-227.26		-227.260	
Rho-Sq ρ^2	0.398		0.456	
Rho-Bar sq	0.386		0.445	

Table 4: Validation Test Results

Trip Purpose	Log Likelihood Ratio		LRTS	No. of Parameters	Critical X^2 (0.05)
	Unrestricted	Restricted			
Business (without mode perception)	- 47.69	- 54.02	12.11	7	14.07
Business (with mode perception)	- 45.42	- 52.83	14.82	9	16.92
Social (without mode perception)	- 81.41	- 84.99	7.17	8	15.51
Social (with mode perception)	- 76.79	- 79.53	5.48	9	16.92

6.4 Effect of Perceptual Variables on Mode-Choice Models

The null hypothesis that perceptual variables do not add to the explanation of the mode choice behavior was tested using the following likelihood ratio test statistics:

$$LRT = -2\left(L(\beta_1) - L(\beta_2)\right)$$

Here,

$L\ (\beta_1)$ = The log likelihood of model with perceptual item

$L\ (\beta_2)$ = The log likelihood of model without perceptual item

This test has χ^2 distribution with $K_1 - K_2$ degrees of freedom. This test was performed on both the business, and social and recreational trip models. Based on the test statistics the null hypothesis can be rejected at 95% confidence level. It implies that a significant difference exists between models with and without mode perceptions.

7. DISCUSSION OF THE RESULT

A computer program was prepared to estimate the model share for each trip purpose which also calculates the utility of each mode for every traveler, and then the probability of using each alternative is estimated. The alternative which has the highest probability is predicted to be the chosen mode for that particular individual. The number of travelers correctly predicted will be summed up for each alternative and compared with the actual share to yield the prediction ratio. The overall prediction ratio for business trips was improved when models containing perceptual variables were used for prediction. The prediction ratio increased for all modes, both in case of validation and calibration data. When the models incorporating the mode perceptions were used for prediction purposes, there were marginal improvements in the overall prediction ratio from 0.71 to 0.73 for calibration data and from 0.67 to 0.72 with validation data.

As the inclusion of perceptual variables in the mode-choice models provided only marginal improvement and it takes significant amount of time for the respondents, the author suggests not including such variables in planning stage. The models containing perceptions cannot be used as forecasting models as it is not possible to forecast peoples' perception of the travel modes unless another model which can predict these perceptions (for increase as a function of socioeconomic data) can be calibrated. However, studying the perceptions of travelers towards travel modes could be very useful for the operators marketing intercity travel services. By finding the most significant perceptual variables affecting the mode-choice, operators can increase the demand on their modes by improving the service provided by that mode. In this study, comfort was found to be the most significant perceptual variable affecting the choice of a traveler. The bus was ranked the lowest in terms of comfort. Bus operators should look into comfort related aspects in order to improve their public image. This could be done by the provision of comfortable seats, clean new vehicles, bus stops, etc.

Implications ?????

8. CONCLUSIONS AND RECOMMENDATIONS

Among the perceptual items privacy and convenience scales were found to be somewhat correlated. The perceptions of travel modes were affected by the travelers' socioeconomic characteristics and the chosen mode. The bus operators should improve their business strategies in order to improve their low acceptance among the users. The behavior of the traveler was found to be affected by the purpose of the trip which rationalizes the building of models for different purposes to provide insights about the travelers' sensitivity regarding the variables used in calibrating mode-choice models. The study revealed that household income, trip-length, car ownership and duration of stay at destination played a role in explaining the mode-choice behavior of the intercity traveler. Among the four hypothesized perceptual concepts, only the perception of mode comfort played a significant role in the selection of alternative by the traveler for trips. The inclusion of perceptual variables in the mode-choice models resulted in a small increase in the rho-square value and an insignificant improvement in the prediction capability of the models. Hence it is recommended not to include these variables in the planning stages.

The future research should be based on the data of different seasons in order to take care of inter-seasonal variation of the demand for intercity trips. The existing body of literature contains the limited research on intercity travelling choice behavior and mainly focused on a static perspective meaning that only single travel option is being analyzed but the correlation of traveler's depicts that there exists only one way to analyze single travel choice output but the correlation of traveler's number of options during a certain time duration so as to discourage them the traveling behavior from the time variations age.

Due to the extreme hot weather of Saudi Arabia, the local mode choice models should be sensitive to weather conditions. This study recommends studying the perception of mode safety together with the perceptual scales of comfort and convenience in order to fully explain the concept of mode choice. Finally, the investigation of the effect of inclusion of captives as captive models would be interesting research topic.

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